

This document includes the definition of responsibilities and interfaces for the following XFD Groups:

**Experimental Facilities Engineering Group
Magnetic Devices Group
Optics Fabrication & Metrology Group**

Experimental Facilities Engineering Group:

General Responsibilities

The Experimental Facilities Engineering (XFE) Group is a multidisciplinary engineering group responsible for the analysis, design, fabrication, assembly and testing of systems for APS operations and for APS users. The primary areas of responsibility are insertion devices, front ends, and beamline components. The XFE Group is responsible for the mechanical operations of insertion devices in the storage ring and for the mechanical design and construction of new insertion devices and insertion device vacuum systems. It is also responsible for the design, fabrication, and installation of new front ends and the design and fabrication of upgrades for existing front ends. The XFE staff analyzes, designs, and fabricates beamline components, detector systems, and experimental equipment for CATs, as requested.

General Interfaces

None

Group-Specific Interfaces

ASD Accelerator Physics

The XFE Group is responsible for the mechanical, electronic, and control system design, fabrication, and installation, and commissioning of VUV diagnostics, VUV transport lines, and the VUV experimental station for LEUTL using LDRD and Capital Equipment funds expressly appropriated for this purpose.

The XFE Group is responsible for arranging the safety review of the LEUTL end station experiment programs.

ASD Controls Group

The ASD Controls Group is responsible for the ID control systems and all related electrical components and wiring, including internal wiring of the installed IDs and the encoder interface electronics. The XFE Group is responsible for the mechanical mounting of the encoder. The Controls Group will provide the necessary documentation of the internal wiring of the IDs in order for the XFE Group to properly wire new devices (existing design). Assistance and/or consultation of internal wiring for these IDs will be provided as necessary. The Controls Group will also provide the cables necessary for the proper operation of the IDs. The Controls Group also is responsible for the software to control and operate the IDs.

The XFE Group provides to the ASD Controls Group the mechanical specifications and performance requirements for the control of new IDs and front ends.

ASD Electrical Systems (ES)

The ASD ES Group is responsible for the design, fabrication, installation and maintenance of the PSS and FEEPS systems required for front ends. The XFE Group will provide a list of controlled and monitored devices for new front ends.

The ASD ES Group is responsible for the maintenance of power supplies, power supply interlocks, and power supply cabling for IDs. This includes installed electromagnetic devices (EMW and CPU), as well as dipoles and correctors associated with canted undulator straight sections.

The ASD ES Group is responsible for the design, fabrication, installation, and commissioning of new power supply systems for new IDs and for dipole magnets and correctors associated with new IDs, such as for the canted ID. The XFE Group will provide performance requirements.

The XFE Group will consult with the Electrical Distribution section of the ES Group on the electrical requirements for new front ends.

The ES Group is responsible for conducting formal reviews and for approving all new electrical installations by the XFE Group for NEC Code and safety violations.

ASD Mechanical Engineering (ME)

The ASD ME Group, Water Systems subgroup will fabricate front-end water manifolds and will install the manifolds and piping for new front ends, as requested by the XFE group.

ASD RF

None

ASD Survey and Alignment

The ASD Survey and Alignment Group fiducializes and aligns IDs, ID vacuum chambers, front-end components, and beamline components, as requested by the XFE Group.

ASD Vacuum Technology

After the XFE Group installs and commissions a new ID vacuum system, the ASD Vacuum Technology Group is responsible for maintenance. The XFE Group is responsible for fabricating spare ID vacuum chambers, as requested by the ASD Vacuum Technology Group. The ASD Vacuum Technology Group will stock all ancillary spares, such as NEG and ion pumps, RGA heads, etc.

New front-end design, fabrication, and installation, including mechanical, vacuum, conventional facilities, and water, are the responsibility of the XFD-XFE Group.

Installation and commissioning of new front ends, including ratchet-wall collimators and conventional facilities, will be the responsibility of the XFE Group. Upon request from the XFE Group, the ASD Vacuum Technology and ME/Water Systems Groups will assign staff and technicians to support the initial installation. Assignment to the front-end installation team will be mutually agreed to by the XFE, ME/Water Systems, and Vacuum Technology Group leaders. After the XFE Group commissions new front ends, the ASD Vacuum Technology Group will be responsible for maintenance. The ASD Vacuum Technology Group will determine the need for spares for front ends and will request the XFE Group to fabricate these spares. The fabrication cost will be the responsibility of the ASD Vacuum Technology Group.

Design and fabrication of upgrades to existing front ends will be the responsibility of the XFD-XFE Group. Installation of component upgrades will be performed by the ASD Vacuum Technology Group, and/or ME/Water Systems Group, under the supervision of XFE engineers.

AOD Diagnostics

AOD Diagnostics is responsible for providing the design of RFBPMs for ID vacuum chambers to the XFE Group. The XFE Group will procure the RFBPMs and install them into the chamber. Hookup of the RFBPMs to electronic systems is the responsibility of AOD Diagnostics.

AOD Diagnostics is responsible for the engineering analysis of XBPMs for front ends and beamlines. The XFE Group will perform the mechanical engineering and design in accordance with detailed specifications provided by AOD Diagnostics.

AOD Operations Analysis

AOD Operations Analysis provides the electron beam specifications to the XFE Group that are used for defining IDs, ID vacuum chambers, and front-end design requirements.

AOD Beamline Control and Data Acquisition

TBD

AOD Information Systems Support (Computer Support and MIS Sections)

AOD Information Systems Support (ISS) (Computer Support) is responsible for maintaining the network infrastructure for XFE computers as requested by the XFE Group and in accordance with standards established by AOD ISS.

AOD ISS (Computer Support) is responsible for approval of XFE procurements of PC, MAC, and UNIX computing hardware and software and maintenance of XFE PC, MAC and UNIX computing hardware and software. This applies to systems used for accelerator controls, administrative computing, and design/drafting.

The AOD ISS Group is responsible for data backup on all UNIX, MAC, and PC-type computers used by XFE employees.

Computer security measures for all XFE computers will be defined and implemented or verified by the AOD ISS Group.

AOD User Administration and Support

None

XFD Magnetic Devices Group

Specification of magnetic performance and detailed design of the magnetic circuits is the responsibility of the Magnetic Devices (MD) Group. Mechanical design, fabrication, installation, and assembly of insertion devices is the responsibility of the XFE Group.

The XFD MD Group is responsible for the commissioning of new IDs. The XFE Group is responsible for the commissioning of CPU power supplies and corrector power supplies prior to turning over to ASD-ES for maintenance.

The XFE Group is responsible for the design and fabrication, and installation of mechanical and electronic systems for magnetic measurements of IDs according to specifications provided by the MD group. The XFD MD Group is responsible for maintenance of these systems.

Installation and removal of all undulators and wigglers in the storage ring is the responsibility of the XFE Group. The XFE Group is responsible for arranging transport of undulators between the Magnetic Measurement Facility (MMF) and storage and between the MMF and the storage ring. The XFE Group is responsible for receiving and shipping IDs off site.

The XFE Group is responsible for the mechanical design, fabrication, installation and assembly of vacuum chambers and diagnostics for LEUTL and for other 4th-generation experiments with written cost, schedule, and performance specifications.

The XFE Group is responsible for the mechanical, electronic, and control system design, fabrication, and installation, and commissioning of the VUV diagnostics, the VUV transport line, and the VUV experimental station for the LEUTL using LDRD and Capital Equipment funds expressly appropriated for this purpose.

APS CAT Community

The XFE Group is responsible for the engineering and thermal analysis, design, and manufacturing of beamline components for APS CATs with specific written agreements on cost, schedule, and performance specifications.

The XFE Group is responsible for the development of software for detector imaging systems .

The XFE Group provides software tools and solutions for support of the scientific programs of XFD. Focus is on high-performance tools for data acquisition and analysis that are well integrated into the computing environment of the APS.

Magnetic Devices Group

General Responsibilities

The Magnetic Devices (MD) Group is responsible for the physics and magnetic design of insertion devices (IDs) and pulsed and conventional magnets at the APS. For IDs, the MD Group consults with the users and provides calculation codes and other information to help the users determine the characteristics of the light from possible types of IDs. Once the users have selected the type of ID they want, the MD Group will either specify and procure the device or, if it is to be built at the APS, will complete a magnetic design for the device. For novel types of IDs (e.g., superconducting), research and testing may be carried out first to determine what is feasible. For conventional or pulsed magnets, the MD Group designs to meet the specifications of those requesting the magnet, who may be APS accelerator specialists or users needing a magnet for their beamline. The mechanical design and construction of IDs and other magnets are done by other groups in consultation with the MD Group, then the MD Group is responsible for the magnetic measurements of the completed devices. The MD Group also participates in the commissioning of new types of IDs.

The MD Group participates in the design, fabrication, installation, commissioning, and operation of the undulator line for the APS FEL, including the diagnostics and delivering the beam to the FEL users. The MD Group is also a key participant in the LCLS collaboration, to which APS is contributing the undulator line.

The MD Group also participates in radiation dosimetry of IDs and in some of the efforts to determine the radiation sensitivity and means of protection of the permanent magnets.

General Interfaces

None

Group-Specific Interfaces

ASD Accelerator Physics

The MD Group is responsible for the magnetic field quality of the undulators used in the APS FEL. The MD Group shares responsibility with the XFE Group for the design, fabrication, installation, and commissioning of the optics for the APS FEL undulator line and output beam transport, using LDRD and Capital Equipment funds expressly appropriated for this purpose.

ASD Controls Group

In the past, the MD Group has been responsible for the initial version of the control systems for the IDs, turning responsibility for controls over to other groups after commissioning. This is changing, and the ASD Controls Group will be assuming responsibility for the ID control systems and all related electrical components and wiring, including internal wiring of the installed IDs and the encoder interface electronics. The Controls Group also will be responsible for the software to control and operate the IDs, and for supplying, maintaining and upgrading the software and hardware needed to control and operate the IDs in the ID magnetic measurement room. The MD

Group provides both the XFE and the ASD Controls Groups with requirements for the control of new IDs.

ASD Electrical Systems

In the past, the MD and XFE Groups have been responsible for providing any power supplies needed for the IDs. So far, the only electromagnetic IDs have been the elliptical multipole wiggler (EMW) and the circularly polarized undulator (CPU). Responsibility has passed to the ASD ES Group after commissioning. This has occurred for the EMW but not yet for the CPU. Responsibility for the CPU power supply will soon be given to the ES Group. Responsibility for developing, providing, maintaining, and upgrading power supplies and power supply cabling for future IDs will belong to the ES Group.

The ASD ES Group has always been responsible for power supplies, interlocks, and cabling for conventional and pulsed magnets in the APS facility. This will continue, and the MD Group will provide specifications to the ES Group for new supplies.

Some electromagnets will be designed by the MD Group for user beamlines. There is a possibility that the ES Group may be asked to provide a power supply for the magnet, if the needed supply is not easily purchased and the ES Group is able to help. This will be decided when/if the circumstance arises.

ASD Mechanical Systems

Conceptual designs of the conventional magnets will be done by the MD Group of XFD. The Mechanical Engineering (ME) Group will do their mechanical designs and prepare drawings for fabrication. The ME Group will also maintain the existing conventional and pulsed magnets of the APS.

ASD RF Systems

None

ASD Survey and Alignment

The ASD Survey and Alignment Group fiducializes and aligns IDs as requested by the XFE and MD Groups.

ASD Vacuum Systems

None

AOD Main Control Room Operations

The MD Group follows Operations procedures during access times and when commissioning or checking IDs using stored beam.

AOD Operations Analysis

AOD Operations Analysis provides the electron beam specifications to MD Group that are used for defining ID requirements and for calculating the properties of the ID light. The MD and AOD Groups work together on the commissioning of IDs.

AOD Diagnostics

The MD Group provides remeasurement of the magnetic properties of the Sector 35 undulator, if needed.

AOD Beamline Control and Data Acquisition

None

AOD Information Systems Support (Computer Support and MIS Sections)

AOD Information Systems Support (ISS) (Computer Support) is responsible for maintaining the network infrastructure for MD computers as requested by the MD Group and in accordance with standards established by AOD ISS.

AOD Information Systems Support (Computer Support) is responsible for approval of the MD Group's procurements of PC, Mac, and UNIX computing hardware and software and maintenance of the MD Group's PC, Mac and UNIX computing hardware and software.

The AOD Computer Support Group is responsible for data backup and computer security measures on all UNIX, Mac, and PC-type computers used by the MD Group employees and connected to the network.

AOD User Administration and Support

None

XFD Experimental Facilities Engineering Group

Specification of magnetic performance and detailed design of the magnetic circuits is the responsibility of the MD Group. Mechanical design is the responsibility of the XFE Group. Fabrication, installation, and assembly of IDs is shared between the MD and XFE Groups.

The MD Group is responsible for the commissioning of new IDs. The XFE Group is responsible for the commissioning of CPU power supplies and corrector power supplies prior to turn over to the ASE-ES Group for maintenance.

The XFE Group is responsible for the design and fabrication, and installation of mechanical and electronic systems for magnetic measurements of IDs according to specifications provided by the MD Group. The MD Group is responsible for maintenance of these systems.

Installation and removal of all undulators and wigglers in the storage ring (SR) is the responsibility of the XFE Group. The XFE Group is responsible for arranging transport of undulators between the Magnetic Measurement Facility (MMF) and storage and between the MMF and the SR. The XFE Group is responsible for receiving and shipping IDs off-site.

The XFE Group is responsible for the mechanical design, fabrication, installation and assembly of vacuum chambers and diagnostics for LEUTL and for other 4th-generation experiments with written cost, schedule, and performance specifications.

The XFE Group is responsible for the mechanical, electronic, and control system design, and the MD and XFE Groups share responsibility for the fabrication, installation, and commissioning of VUV diagnostics, VUV transport line, and VUV experimental station for LEUTL using LDRD and Capital Equipment funds expressly appropriated for this purpose.

APS CAT Community

The MD Group consults with the users about IDs and provides calculation codes and other information to help the users determine the characteristics of the light from possible types of IDs. Once the users have selected the type of ID they want, the MD Group will either specify and procure the device or, if it is to be built at APS, will complete a magnetic design for the device.

The MD Group also occasionally removes IDs from the storage ring for rechecking and retuning if necessary. For IDs that have been damaged by radiation, the MD Group will retune the device and reinstall it if possible, and if necessary see to a more extensive repair of the ID.

Financial details of IDs are handled by upper management on a case-by-case basis.

The MD Group will design magnets for use by users on their beamlines. The mechanical design of these magnets has been carried out by the XFE Group in the past but will be done by the ASD-ME Group in the future.

Optics Fabrication & Metrology Group:

The group consists of four areas, all of which are concerned with x-ray optics: **Fabrication/Characterization, Metrology, Deposition, and Mirror Modeling/Consulting**. In the first three of these areas, APS beamline staff and APS users can avail themselves directly of certain services. Once the principal staff member in charge and the group leader agree to accept it, a formal work request form is filled out and resources are allocated to fill the request. In most cases, this involves an agreement to pay for the work on an hourly basis. But in some cases, the work is performed without charging and would be considered collaborative with the intent to share coauthorship on a publication. The **Mirror Modeling/Consulting** effort only functions in collaborative mode. Among the reasons, a work request may be rejected are: it is beyond the achievable specifications of the available tools or the schedule asked for cannot be met. However, collaborative efforts often result from specifications that are beyond the state of the art.

Fabrication and X-ray Characterization

Crystal elements for use on beamlines can be fabricated per request. Only for silicon optics can the raw starting material be supplied by the OFM Group. For germanium and other types of crystals, the raw material must be supplied by the requester. Finished crystals for use as monochromators, analyzers, small x-ray mirrors, or thin-film substrates can be provided. In-house equipment for orienting, sawing, lapping, polishing, dicing, and etching are available. X-ray equipment to

characterize the optics is used for quality assurance. This equipment consists of a triple-crystal diffractometer , double-crystal diffractometer, and an x-ray topography camera.

Metrology

In a dedicated metrology laboratory, measurements using visible light interferometry are performed on x-ray optics up to 2 meters in length. This laboratory is climate controlled for precise measurements. Interferometers for figure and finish measurements include: a long trace profiler, Wyko Topo-2D interferometer, Fizeau interferometer, and an atomic force microscope. All these instruments can only be operated by OFM staff.

Deposition

Thin-film deposition via magnetron sputtering is available. Not only x-ray mirror coatings, but also multilayer films, can be prepared for use as diffraction optics for hard x-rays. Two sputtering chambers are available. Quality control for the thin films is done with ellipsometry and x-ray reflectometry.

Mirror Modeling and Consulting

Thermal modeling calculations and designs for cooled mirrors can be obtained from the OFM Group.